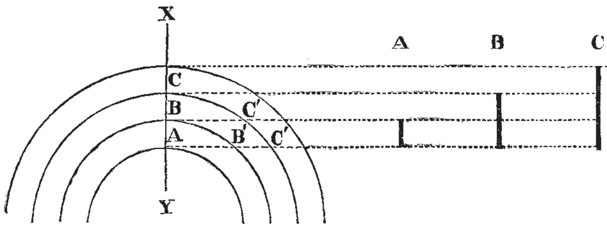
therefore probably best represented in prominence-spectrum. B and C, layers further from the sun, and therefore cooler, and therefore probably best represented in spot-spectrum.

If this be so, when we can see the lines of these layers we shall see something like this—



The lines of A—the hottest layer—will be brightest and shortest.

The lines of B—the next cooler layer—will be less bright and longer, and will also go down to the sun, on account of the part of the layer at B, although it is unrepresented at A, along the section X—Y.

And so on with C.

In an eclipse we have a condition in which the atmospheric light is gradually withdrawn. The lines should appear, therefore, in the order of their lengths; that is, the line which turns out to be longest should be the last to appear, and this is a magnificent proof that the substance which produces the line does not extend down to the sun, for if it did it should be brightest at bottom, and should at first appear as a short line.

Now what were the facts? Dealing with the region between F and *b*, and not all of that, and especially with the three iron lines I have so often mentioned, this was the order of appearance—

May 17, 8.18 a.m., saw F and T_1 very short.

(T_1 meaning the single iron line of the three *w l* 49233 so constantly seen by Tacchini in prominences).

8.19 ... F + T_1 + 4933 short.
8.20 ... F + T_1 + 4933 + *b* long.
8.23 ... F + T_1 + 4933 + *b* + T_2 short.

(T_2 meaning a high temperature iron line at *w l* 50176, constantly seen by Tacchini with 49233).

At this time the darkness sensibly decreased, and then for the first time several long thin lines suddenly burst out.

8.23.30: Single iron line at 49565, and double at 4918 and 49195 and line at 49325, the last three being the longest. Other long lines made their appearance, but their positions were not absolutely determined.

Totality was announced at 8h. 25m. 42s., and it was arranged that I should then change my instrument. I fancy the signal was given a little too soon, for when I went to my 3¾ telescope to study the structure of the corona the cross wires were still some distance from the point at which the sun disappeared; but be this as it may, I missed the flash, but this was unimportant, the real work was done. Still this is a point so crucial that we ought not to be satisfied till all these changes, even in luding the flash, have been photographed on a moving photographic plate, an idea which struck me too late for utilisation during the present eclipse.

Next, as to the structure of the corona. Again the predictions were fulfilled; we were in presence of a repetition of the eclipse of 1871; everything special to that of 1878 had disappeared. There was absolutely no structure near either pole. I was using the same telescope as in 1878, when this feature was so marked, so there can be no mistake on this point. The filamentous character of the streamers, a marked feature in 1871, was however not so decided.

As with the structure so with the ring spectrum. The rings so bright in 1871, so conspicuously absent in 1878, were again visible, but with a Rutherfurd grating they were not so obvious as I at all events expected to find them. As seen at mid-eclipse, 1474 was the faintest ring, and C the brightest.

With regard to the spectrum of the corona as seen with an ordinary tele-spectroscope, arranged to give as much light as possible, I have not so much to say as I had hoped, for the reason that the totality lasted longer than we counted upon. The result of all the preliminary *pourparlers* had been to fix upon sixty-five seconds as the most probable duration of totality, or rather as the duration to be provided for especially from the photographic point of view, since a photograph exposed during totality would be ruined if the sun reappeared before the cap of the camera had been replaced. Sixty-five seconds having elapsed from the announced commencement of totality, I went to the corona spectroscope which I should have gone to ten seconds earlier (but the comet had taken five seconds, and the grating observation had been more uncertain than I had expected). At the moment I made the observation the eclipse was over, but still I noted F, and 1474, and C, bright, and extending right across the field, and a *banded spectrum*, that is to say, not a continuous spectrum certainly, but into maxima and minima, though the minima gave no signs of dark lines. The observation, however, was almost instantaneous, and too much importance must not be attached to it.

Here my notes must close for the present; 104° in the shade is not conducive to writing, even if camels were not growling, and flies teasing, as they can tease in Egypt. J. NORMAN LOCKYER

Siout, May 21

(*To be continued.*)

BIOLOGY AND AGRICULTURE

RECENT advances in our knowledge of the lowest forms of life have tended to bring into prominence not only their relation to disease but to the ever-increasing importance of the part which they play in our arts and industries. Probably in none of the industrial arts, save those concerned with fermentation, commonly so called, has the progress of this branch of biology shown such remarkable development as in its bearing on the art of agriculture.

It has even been suggested that a *bacterium* is at the bottom of the present state of agricultural depression, and there is a considerable amount of force in this suggestion. The loss of nitrogen from the soil in the form of nitrate is one of the most serious difficulties with which the farmer has to contend; and, as this loss takes place by the washing out of nitrates in the drainage and its diffusion into the subsoil below the reach of the

roots of plants, it is necessarily greater in wet seasons such as have been the rule for the last few years.

We believe that Pasteur was the first to suggest, twenty years ago, that the process of nitrification going on in soils and waters might be due to the agency of an organism; but it was not until the last five years that the researches of Schlösing and Müntz and of Warington conclusively showed that this is the case and that the organism is a *bacterium.* This *bacterium* is present in all fertile service soils and under the proper conditions of temperature, moisture, supply of oxygen, and presence of salifiable base is continually converting ammonia and nitrogenous organic matter, which has passed the putrefactive stage, into nitrates. That nitrates are the chief form from which most crops and especially the cereals assimilate their nitrogen is now admitted generally, even by the few physiologists who still cling to the belief that plants can assimilate free atmospheric nitrogen ; the very great use of this nitrifying organism is thus apparent. It may be remarked in passing that this Schizomycete is able to effect a change in a mineral substance, ammonia, causing its oxidation into nitric acid, all other known organised ferments being concerned in the transformation of organic bodies, and this is an operation hitherto unsuspected in the life of any Bacteria.

Nitrification takes place in soils most rapidly in the hot months of the year, and as a cereal crop assimilates little or no nitrogen after June, but merely transfers that already taken up and present in the roots, stems and leaves to other organs, it follows that, on a cornfield, in the late summer and the autumn months, nitrates will be formed and, will, in the event of wet weather, be readily washed out of the soil.

Observations made during many years at Rothamsted, and recently published by Messrs. Lawes, Gilbert, and Warington,[1] show the extent to which this loss of nitrates may occur. They find that on land uncropped and unmanured, that is, a bare fallow, during 4 years 1878-1881, nearly forty-two pounds of nitrogen per acre per annum, equal to nearly two and a half hundredweight of ordinary nitrate of soda, was lost by drainage. They also estimate that on land under continuous wheat cropping from ten to twelve pounds of nitrogen per acre per annum was lost by drainage from plots which received no nitrogenous manure. When nitrogen is applied in the manure, considerably larger quantities are lost in the drainage, and this is exclusive of that diffused into the lower layers of soil below the reach of plant roots, and of that which may under certain conditions be lost by deduction to elementary nitrogen.

In an ordinary rotation the loss of nitrogen will be considerably less than in these experiments, for crops will often be growing for months after the cereal crop is removed, and thus conserve the available nitrogen and store it up for future use. It is however obvious, that, with a bare fallow favouring the production of nitrates, followed by a wet season, a very considerable loss of available nitrogen will occur through loss of nitrates, and it becomes a matter for the farmer to consider whether it is to his advantage, for the sake of cleaning his land, to take the risk of this loss and supply the nitrogen at a cost, in ammonia, salts, or Chili saltpetre, of nearly a shilling per pound, or on the other hand, adopt some system of cultivation and cropping by which much of the loss may be obviated. On some soils the growth of an autumn green crop would save most of the nitrates and leave the land in fair condition for a succeeding crop ; naturally the decision as to the advisability of such a course must rest in each case with the individual farmer.

[1] *Journal of the Royal Agricultural Society* [2] xvii. and xviii. ; and *Journal of Society of Arts*, April 7th, 1882.

The Agricultural mind appears to always require a panacea from the scientific man before it will accept his results as of any use. At a recent meeting of the Farmers' Club it was observed by a leading agriculturist, that, although Mr. Lawes (now Sir J. B. Lawes) had discovered the way in which nitrogen was lost, he had not told the farmer how to retain the goods effects of nitrogenous manures in adverse seasons. The discovery of the manner in which the loss occurs is, however, an immense step in the right direction, and moreover Lawes and his colleagues have clearly shown that with a growing crop on the land the loss is very greatly lessened.

This *bacterium* of nitrification is but one of a great number of the lower forms of life now engaging the attention of scientific men, which are, or ought to be, of immense interest to the scientific pursuit of agriculture. The researches of Pasteur on the life history of *Bacillus* of Anthrax, Aitken and Hamilton's investigations now being conducted into the causes producing braxy and louping ill ; and the study of the organisms concerned in the changes which occur during the souring of milk and the ripening of cheese are kindred studies bearing in a direct manner on the daily practice of the farmer. Of no less interest too is the biological work done by Kühn and Liebscher, which has traced the *beet sickness* to the presence of a Nematode, while the investigations into the life history of *Hemileia vastatrix*, the too well-known coffee leaf disease, the *Plasmidiophora*, which is the proximate cause of *anbury* in turnips, and the fungus of potatoe disease, all point to the growing relation between the kindred sciences of biology and agriculture. Illustrations might be multiplied almost indefinitely but these are of sufficient importance to show that the work of the microscopist and biologist has a wide and deep influence, first of all on the practice of agriculture, and through it on the comforts and the pockets of the consumers at large.

THE TRANSIT OF VENUS, 1874

Account of Observations of the Transit of Venus, 1874, *December* 8, *made under the Authority of the British Government.* Edited by Sir George Biddell Airy, K.C.B., Astronomer-Royal.

THIS volume, recently published under the authority of the Treasury, contains the official account of observations of the last transit of Venus, by the five expeditions organised at the public expense and the reduction of the observations.

In an Introduction Sir George Airy briefly recapitulates the various steps taken by himself with the view to the efficient observation of this phenomenon, from his first communication to the Royal Astronomical Society in April, 1857, "On the means which will be available for correcting the measure of the sun's distance in the next